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Introduction

1.1 Global Water Risks and Local Practices

One in four people lack safe and reliable drinking water, most of whom live in Asia and Africa (WHO/UNICEF, 2023). Elevated levels of arsenic and fluoride are slowly and silently poisoning tens of millions of groundwater dependent populations in the Indo-Gangetic delta of South Asia (Fendorf et al., 2010) and the East African Rift Valley (Ligate et al., 2021, Reimann et al., 2003), respectively. Rising global temperatures are invigorating cyclones and storm surges in the Indian Ocean. In May 2020, cyclone Amphan inundated coastal settlements in India and Bangladesh, exacerbating the hardships of the COVID-19 lockdown (Kumar et al., 2021). In the Horn of Africa, multiple years of failed rainfall have resulted in the worst drought in 70 years in 2022, causing water and food scarcity for 25 million people and tens of millions of livestock (OCHA, 2023). The alarming state of water risks across the world are increasingly portrayed by the media. Photos of emaciated children standing by animal carcasses, men boating along indigo tainted waters, or women wading through waist-deep flood waters narrate the diverse water risks experienced every day.

Stories from North America and Europe are increasingly making headlines as well. In 2014, a major public health crisis unfolded in the city of Flint, Michigan, after a switch in the municipal water source resulted in insufficient corrosion control in aging pipes, leading to high levels of lead in the water supply (Pauli, 2019). In the UK, since 2020, the issue of river pollution has gained increased political attention as private water companies have been found to be regularly releasing untreated sewage into rivers (House of Commons, 2022).

Over two billion people live with security risks every day. The wealthy can often buy their way out of water security risks, the poor have fewer options. The risks the poor face each day can be unpredictable or relentless with no quick or simple solution. We set out to document the risks and responses that poor people face through water diaries in Bangladesh and Kenya, two countries with different but extensive water security challenges. We use the term ‘poor’ as shorthand to reflect individual, household and community vulnerability, exclusion, and deprivation. Equally, their strategies, practices and creativity reflect the resilience, ingenuity, and stoicism of the poor in a world of increasing water security risks which they did not engineer, but for which they face the greatest risks to their lives and livelihoods.

Water risks are generally defined by the privileged and experienced by the poor. Attribution of and blame for water risks can take many forms with little account for the local lived practices which attempt to adapt and mitigate the most harmful outcomes. In the case of water, these outcomes can relate to human health and well-being, ecosystems, or economic development, and can be driven by multiple environmental, financial, institutional, and social factors operating at different spatial and temporal scales (Hoque et al., 2019). Environmental factors encompass the geographical and seasonal distribution of water resources and hazards, as exemplified by the public health risks from naturally occurring arsenic or fluoride in groundwater, and crop failures and livestock deaths from delayed onset or failed rainy seasons. Financial drivers of water risks range from capital expenditure gaps in water supply or wastewater treatment infrastructure to poor recovery of operational costs due to non-payment of user fees. Institutional arrangements define how responsibilities for risk mitigation are allocated among national and local governments, private sector, donor organisations and households, ranging from day-to-day service provision to water sector regulation and monitoring (Hope and Rouse, 2013). Social factors, such as poverty, gender, race and power dynamics, can disproportionately put certain population groups or individuals more at risk than others.

Global policies to address water risks have undergone several shifts in ideologies in the past few decades, depending on how the drivers of risks are framed (Hope et al., 2019, Gunawansa et al., 2013). Investments in large-scale infrastructure such as dams and centralised piped schemes gained momentum from the mid twentieth century to bring water to the people in growing cities, while deltaic floodplains were engineered with embankments, sluices, and canals to protect coastal populations from floods and storm surges. Water was viewed as a social good, with responsibilities for financing and management resting with the public sector. For nations emerging from colonial domination, overseas development aid served as the main funding source, allowing international donor organisations to intervene in national development policies based on western ideologies and practices. Infrastructure-led solutions also permeated the rural water sector in low-income countries, with low-cost handpump technologies being popularised to shift rural populations from surface water to groundwater sources. The type of water technology used became synonymous with water safety, with access to improved sources being the global policy target until today.

Since the late 1980s, the focus of risk mitigation expanded from a sole emphasis on financial factors to include institutional arrangements for allocating responsibilities and blame. Alongside the UK's privatisation of the water sector, various forms of public–private partnerships were implemented in large cities in Latin America, the Middle East, and the Asia-Pacific (Bakker, 2011). Neoliberal policies promoted water as an economic good, with the focus being on getting the prices right to ensure cost recovery and affordability. Decentralisation drives responsibilities for rural water provision to local governments, often lacking financial and institutional capacity to fulfil their mandates. Community-based management became the standard model for operation and maintenance of rural water infrastructure based on demand-driven ideologies. Unlike urban areas with subsidised piped services managed by utilities, rural users are left to their own devices, having to gather money and spare parts for repairing their pumps and pipes. An extensive body of evidence from Asia and Africa shows that the community-managed model has yielded unsatisfactory outcomes, as waterpoints are poorly managed and often abandoned after a few years, with the expected lifetime rarely achieved (Foster, 2013, Whittington et al., 2009, Harvey and Reed, 2007). Uncoordinated infrastructure investments by governments and donors create a complex tapestry of water sources often located adjacent to existing waterpoints in a graveyard of well-meaning intentions.

Global and national monitoring of progress in water services in the twenty-first century have been defined by the United Nations' Millennium Development Goals (MDG) and Sustainable Development Goals (SDG). In line with the infrastructure-led provision approach, MDG Target 7c narrowly focused on measuring 'access to an improved source'. SDG Target 6.1 expanded global ambition from access to a service delivery approach, with a focus on providing safely managed services calibrated by water quality, reliability, affordability, proximity, and equity. Yet, given the costs and logistics of large-scale data collection, nationally representative surveys and censuses still focus on the 'main source of drinking water', with services defined as 'safely managed' when a source is available on demand, free of faecal contamination and on-premises, and 'basic' when it is within 30 minutes of dwelling (WHO/UNICEF, 2017). The SDGs also include ambient water quality, targeting to reduce disposal of untreated wastes into waterbodies (SDG 6.3). However, monitoring is still at a nascent stage owing to data gaps, political leadership, and an effective monitoring system (UNEP, 2021).

While commonly quoted aggregate statistics – 2.2 billion people lacking safely managed drinking water in 2022 (WHO/UNICEF, 2023) or women in Africa spend 40 billion hours a year in collecting water (UNDP, 2006) – paint the scale of global water risks, local realities are more nuanced. Access to an improved source fails to guarantee water security, as seen in the cases of arsenic, fluoride, and lead exposure despite using handpumps or piped water. Rural populations in developing countries are known to use different sources for drinking, cooking, washing, and livestock, delicately balancing the seasonal variations in water availability, water quality, costs, and distance (Elliott et al., 2019). For those surviving on limited and uncertain incomes, immediate concerns of feeding the family or paying children's school fees may need to be balanced against costly one-off investments in water supply or treatment technologies that can potentially avoid health risks in the long-term (Ray and Smith, 2021). In overcrowded urban slums, women may choose sources of lower quality or higher price to avoid queuing at shared public taps and manage time for paid work, childcare cooking, or other competing needs (Price et al., 2019). Marginalised communities living in polluted and flood-prone riverbanks may choose not to relocate to safer grounds, as doing so may mean losing proximity to markets and income opportunities (Korzenevica et al., 2024).

These examples illustrate that risks are socially constructed, and the 'tolerable' level of risks varies across societies and individuals (Grey et al., 2013) with greater need to include the 'equity' of water risks hidden in what may be tolerable for the majority. The tolerability of risks has influenced decision-making from global to local scales, since before the concept of risk was associated with 'water security'. Water quality guidelines established by the World Health Organisation (WHO), for example, prescribe 10 μg/l as the acceptable threshold for arsenic in drinking water, whereas in Bangladesh, the national standard is set at 50 μg/l as the costs to meet a lower threshold would exceed the public health benefits in a context with extremely high levels of groundwater arsenic. Household and individual water source choices are likewise driven by careful evaluation of the monetary and non-monetary costs and benefits associated with accessing sources with varied quality, distance, costs, and reliability. The 'acceptable' level of risks and water practices are shaped by people's past experiences, physical and psychological capabilities, sociocultural norms, and environmental context.

Pierre Bourdieu introduced the sociological concept of 'habitus' to reflect on people's 'practices' within the 'field' in which they operate. Habitus is 'an active presence of past experiences' (Bourdieu, 1990, p. 54), which governs the continuity and regularity of social practices by providing relatively autonomy from immediate, external constraints. The concept of habitus views one's personal experiences, sociocultural and environmental contexts as salient drivers of present practices, which tend to perpetuate into the future, reactivating in similar structures. Habitus rejects ideas of rational choice, which considers that individual decisions are guided by balanced consideration of costs and benefits of alternative choices, with the option with the highest satisfaction (utility) being chosen. These differences in individual values and preferences may not always conform to policy prescriptions of installing water supply infrastructure that users will regularly pay for and manage for their common good. Knowledge of bacterial or chemical contamination may not deter individuals from using unsafe sources or bathing in polluted rivers unless alternatives can be conveniently incorporated into people's lifestyles. Cultural norms often define whose voices and needs are prioritised in household water decisions, and how responsibilities for collecting and paying for water or managing water infrastructure are allocated between men, women, and children.

This book is about the daily water practices of individuals and households navigating various water risks – from unsafe or scarce drinking water to polluted waterbodies and extreme events – across different environmental, institutional and infrastructure settings. By charting these daily practices, we aim to better understand people's choices and constraints with a granular level of detail that allows us to rethink current policy and practice. Our work provides an empirical basis to accelerate action to reduce water risks and achieve water security in some of the most challenging geographies on the planet.

1.2 Water Diaries as a Lens to Individual Practices

The 'everydayness' of how water risks are experienced by men, women and children, whether in remote villages, in small towns or in bustling megacities, whether in the humid tropical floodplains or in the arid Sub-Saharan landscape, is what inspired us to study the water crisis through 'water diaries'. Diaries are inherently records of the mundane day-to-day activities, the details of which are likely to be erased from our memories after a short time. Fetching water from wells and pipes, or washing and bathing at the river are emblematic of individuals' deliberate and subconscious choices shaped by their *habitus*. Our water diaries were designed to capture these behaviours or *practices* related to water, operating within dynamic *fields* that also include practices by governments, donor agencies, markets, and other individuals.

We focus on four diverse study sites from two countries – Bangladesh and Kenya. The scenes of water crisis in these two countries could not be any different. Located on the low-lying floodplains of three mighty rivers – the Ganges, Brahmaputra, and Meghna – that drain the Himalayan waters into the Bay of Bengal, Bangladesh has plentiful water. Intricately woven by rivers and nourished by four months of monsoon, the country is one of the world's most densely populated places, with a population of 165 million living across an area of 147,500 km^2 (BBS, 2023). On the other hand, about 80 per cent of Kenya's land area is categorised as arid or semi-arid, characterised by two rainy seasons with low and unreliable rains feeding the seasonal rivers. With four times the land area of Bangladesh

(581,000 km^2) and only a third of its population (48 million) (KNBS, 2019a), most of Kenya's rural areas and small towns are sparsely populated. While riverine floods, cyclones and storm surges are common in Bangladesh, Kenya is affected by prolonged droughts. Despite the stark contrast in environmental risks, the two countries share some common institutional and infrastructure risks, including capital financing gaps, operation and maintenance challenges, and regulation of water resources and services.

The shared institutional and infrastructure contexts may be traced to the similar economic and political histories of the two countries, as shaped by colonisation, dependence on foreign aid post-independence, and neoliberal economic policies imposed by donor organisations. From the nomadic pastoral lifestyles of Kenyan tribes to the ebbs and flows of Bengal rivers – the 'uncontrollability' of the people and nature in these countries was a sharp contrast to colonial ideologies of modernisation. Both countries inherited colonial policy legacies of territorialisation of people by religion, ethnicity or livelihood, as well as the control of water through structural solutions. The reliance on overseas development aid post-independence allowed international financial institutions to shape national policies. Market oriented reforms were implemented in both countries to reduce public spending and mobilise private sector. The rural water sector saw a push towards decentralisation of service delivery, with the focus on scaling low-cost technologies that could be managed by users. With the handpump revolution and community-based management unfolding in the 1980s and 1990s, the infrastructure and institutional ideologies of rural water sector were redefined, a legacy which still dominates.

To study how these diverse environmental, infrastructure and institutional landscape drive daily water practices, we selected four study sites in Bangladesh and Kenya, representing the different aspects of global water crisis (Figure 1.1). These are – (a) Dhaka city, the densely populated capital of Bangladesh, where low-income riverbank settlements risk daily exposure to chemical and pathogen pollution caused by multidecadal discharge of untreated industrial and municipal wastewater into the city's rivers; (b) Khulna district, in the coastal floodplain of southwestern Bangladesh, where rural communities in embanked islands suffer from groundwater salinity and episodic shocks from cyclones and storm surges; (c) Kitui county, representing the sparsely populated semi-arid rural landscapes of Kenya, where low rainfall subject to inter-annual variability results in acute water crisis and high prevalence of surface water use by communities and schools; and (d) Lodwar town, a rapidly urbanising small town in the parched drylands of northwest Kenya, where the existing water supply utility grapples to meet the water demands of a growing population on the banks of a seasonal river with shocks from annual flash floods. We write about each of these sites in Chapters 2–5 of this book.

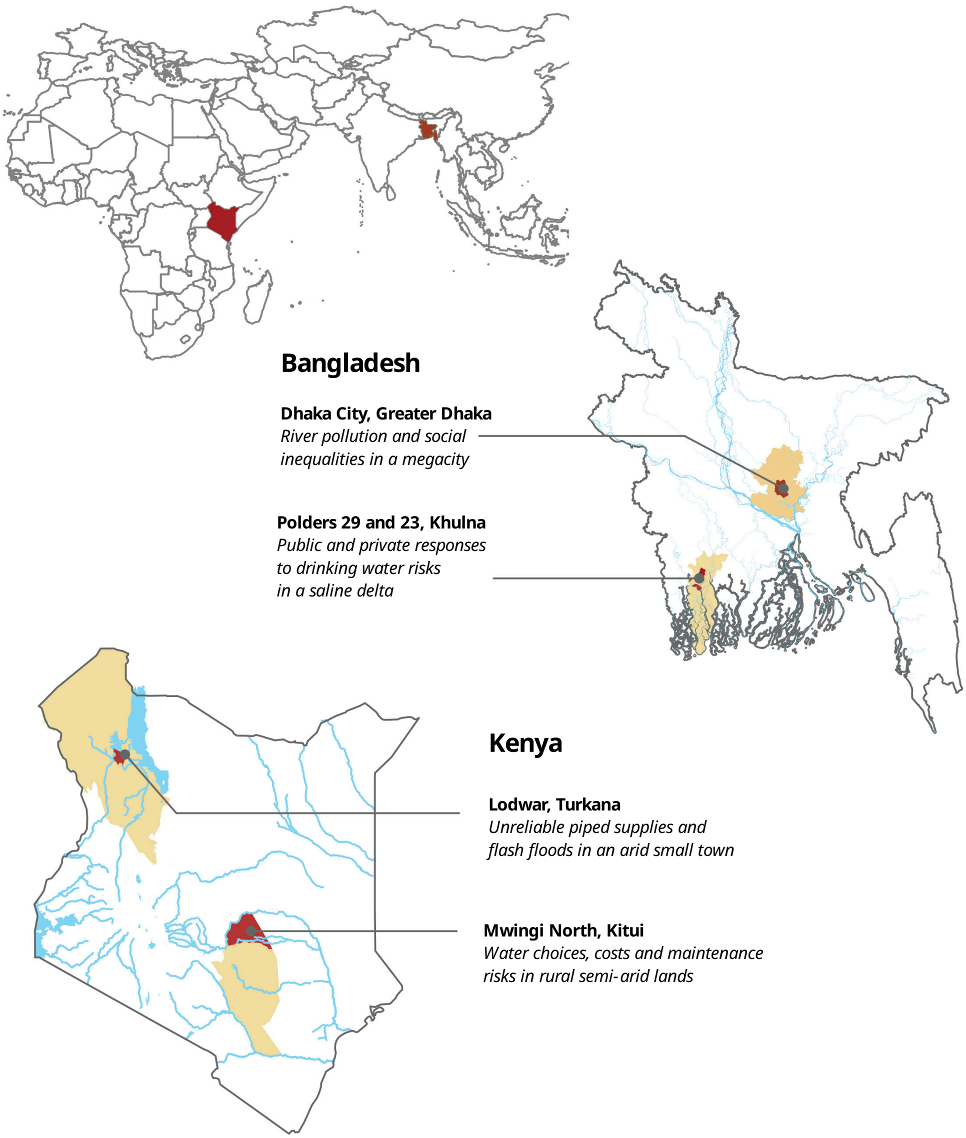

Figure 1.1 Map showing the four study sites presented in this book.

The daily water diaries inherently captured the seasonality of water risks and practices at household and individual levels, with the design being adapted to the risks and contexts being studied. The water diaries in Dhaka were different to the ones in the other three sites, as the aim was to observe how different people interact with the rivers depending on place, time of the day, and season of the year. The 'river diaries' involved direct observation of river use behaviour that were recorded by enumerators stationed at 6 selected points along the riverbanks for

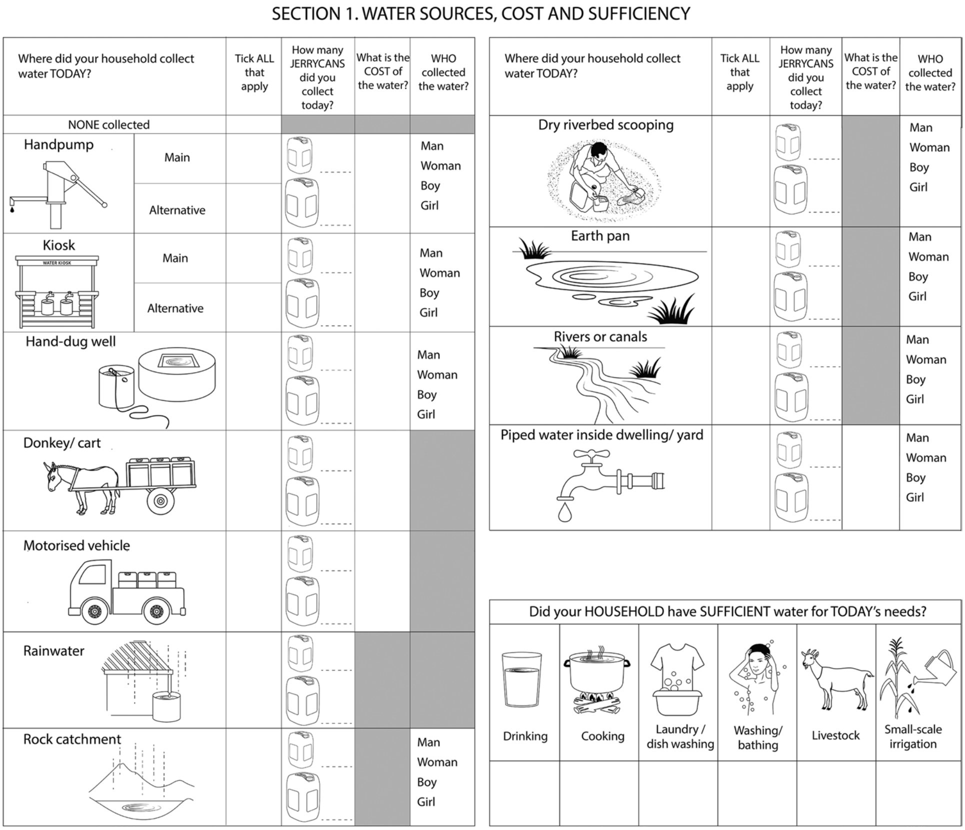

Figure 1.2 The water diary charts designed for Kitui county, Kenya, which were translated to the local language Kikamba. One hundred and fifteen households in Kyuso and Tseikuru wards of Mwingi-North subcounty participated in the diary study from August 2018 to July 2019.

33-days over two seasons – the dry season in January–February and the wet season in August–September 2019. Enumerators noted down who were using the river (that is, adults/children, male/female) for what activities over a 9-hour schedule each day, resulting in more than 10,000 observations with photographs. The water diaries in Khulna, Kitui, and Lodwar focused on drinking water services, studying 120, 115, and 98 households, respectively, for 52 weeks in 2018–2019. The design involved pictorial charts where a member of the household recorded their source, amount and cost of water for that day, along with their overall household expenses (Figure 1.2). Appendix outlines the methodological details of *The Water Diaries*, including the design, piloting, sampling, and experiences from the field.

The diaries were complemented with a suite of methods to understand the environmental, institutional and infrastructure risks shaping the water insecurities in these sites (refer to Appendix). Household surveys were conducted in each site to understand the demographic and socioeconomic profiles, state of water and sanitation facilities, and how water-related challenges rank within other development concerns. The survey households provided the sampling frame for the water diaries in Khulna, Kitui and Khulna, with participants being selected across the spectrum of reported water concerns and welfare. Hydrogeological analysis and climate models sketched the environmental risks related to groundwater and surface water quality, rainfall variability, and climate change. Water infrastructure audits recorded the locations, functionality, investments, and management of different water supply technologies. In-depth interviews with diary participants, riverbank residents, and water point managers provided detailed insights into decision-making processes for navigating water risks.

1.3 Risks, Inequalities, and Policy Responses in Bangladesh and Kenya

Through the diaries and the complementary methods, we explore the social, spatial, and seasonal dynamics of individual and household water practices, in the context of diverse water risks across geographies and sociocultural environments. People's choices and behaviour reveal the 'acceptable' level of risks, as governed by their embodied habits and the wider environmental, infrastructure, and institutional context. We explore how policy responses, addressing institutional, information and investment gaps, can better allocate responsibilities between various public and private actors to manage these risks and reduce inequalities.

We start our narrative with Dhaka (Chapter 2) where river pollution by textiles and leather industries, coupled with sewage and solid waste disposal, has severed the once close-knit bond between the city's people and waterways. Regulatory non-compliance has become normalised as successive military and democratic regimes post-independence have favoured export-oriented economic growth, in line with neoliberal policies prescribed by international financial institutions. Lax enforcement of environmental laws by the state has spurred private governance initiatives by global fashion brands and civil society, with several billion-dollar projects leading to a decentred regulatory framework (Peters, 2022). Water quality monitoring is thwarted by data gaps stemming from infrequent sampling and limited coverage that do not capture the pollution dynamics in the factories or the rivers.

In Chapter 2, we present the seasonal changes in the state of river health across different stretches using data from the first water quality monitoring system for the entire Greater Dhaka watershed. Religious events – the annual Bishwa Ijtema and Eid-ul-Azha – add pollution shocks to the system. Our river water diaries capture the social inequalities in pollution exposure by analysing the location, season and gender disaggregated interactions with the river. Individual practices by low-income riverbank communities reflect their habitus, shaped by past relations with cleaner waterbodies both in Dhaka and in rural areas where many have migrated from. Given the generational timeframes required to achieve river restoration masterplans, there is a moral obligation to take immediate actions to protect these vulnerable people through better water and sanitation facilities and risk communication. This can deter use of river for daily washing, bathing, and irrigation purposes, even when the quality is perceived to be better in monsoon.

We next move to Khulna in the coastal floodplains (Chapter 3), where the waterscape is dominated by mighty tidal rivers interlacing embanked islands. Rural populations obtain their drinking water from tube wells of varying depth. Despite high coverage of tube well – the low-cost improved technology popularised to curb diarrhoeal risks from surface water – access to safe water all year round is compromised by high groundwater salinity. Publicly financed and community managed tube wells have been the dominant approach for rural water supply, leaving out areas with high salinity that require alternative water supply technologies. Uncoordinated investments by donor organisations, households and small enterprises have emerged to plug the gaps through rainwater harvesting systems, small piped schemes, reverse osmosis plants, and pond sand filters.

Household water diaries reflect four behavioural clusters, characterised by commonalities in source choices and expenditures driven by rainfall and local salinity risks. Yet within clusters, individual preferences and habits often explain divergent practices. Uncertain water quality risks from multiple sources, infrastructure operation and maintenance risks, and financial risks related to coping costs jeopardise water security not only in domestic settings, but also in schools and healthcare centres. In this chapter, we advocate for shifts towards professional maintenance services that we piloted in public schools and community health centres in selected unions and later upscaled to the entire district through results-based financing from government and donors. Through regular water quality monitoring, prompt repair and preventative maintenance, supported by up to date information systems and regulatory oversight, professional service delivery has potential to address the long-standing functionality and water safety challenges.

From Bangladesh's water-rich delta, we move to the semi-arid hinterlands of rural Kenya (Chapter 4). In 2016, our study site Kitui emerged as 1 of 47 devolved counties with responsibility for the 2010 constitutional commitment of safe drinking water to all Kenyans. By the 2019 national census, two in five Kitui residents stated their main source of drinking water was surface water, compared to the national average of 23 per cent. This a remarkable statistic given the economic status of Kenya and the investments made over many decades to improve drinking water services by national government, bilateral donors, and non-government organisations (NGOs). Water diaries show shifts from groundwater to surface water sources immediately after rainfall reflecting the cultural predilection towards free and freshly collected waters for people and livestock. The seasonal transition between water supplies reduces revenues for operation and maintenance of piped schemes and handpumps, further aggravating the chronic functionality challenges of community managed systems. While the water sector act explicitly encourages counties to contract private entities to address financing and operational challenges, the commercial non-viability of water services in sparsely populated areas with inconsistent demands deters private sector participation. County leadership and donor cooperation can spur uptake of professional maintenance service delivery guaranteeing reliable and safe drinking water services.

Our final destination is one of the driest inhabited places on the planet – the small town of Lodwar (Chapter 5) in Kenya's northwestern Turkana County bordering Ethiopia, South Sudan, and Uganda. Turkana is famed for being the cradle of humankind with discoveries of the Turkana Boy and Lucy by archaeologists. Lake Turkana is the largest of the great soda lakes of the Rift Valley and marks the terminus of the river Omo, originating in southern Ethiopia, and the Turkwel River flowing from the highlands of southern Uganda. Turkana is an unforgiving dryland with very low rainfall partly due to low-level and high-speed air currents, which transport vast counties of vapour from the Indian Ocean to the Congo basin in the west, leaving Turkana unnaturally dry. The recent discovery of oil deposits and large groundwater reserves has generated excitement and investment in a region purposively marginalised under British colonial rule. In parallel, as a geographic anchor linking the hinterlands of three countries, there has been an ambitious infrastructure project connecting Lodwar with the Lamu Port – South Sudan – Ethiopia Transport corridor project (LAPSSET).

Our diaries reflect the daily water challenges of this rapidly growing town against the backdrop of harsh environment, historical marginalisation, and high poverty. Infrastructure and institutional inefficiencies have resulted in an unreliable piped water service with limited coverage, providing a fertile ground for informal water markets to flourish particularly in unserved peri-urban localities. Those living by the rivers face the dilemma of migrating to remote areas without schools, employment opportunities or water services, or living in fear of being washed away by flash floods. Groundwater is a strategic economic resource in these drylands, with multiple demands from urbanisation, irrigation, and oil exploration. Groundwater sustainability requires knowledge of recharge processes and hydrochemical characteristics to be monitored and managed effectively by government.

The water diaries of urban and rural populations across these four sites illustrate the local experiences of global water risks. We do not intend to prescribe solutions, rather critically reflect on the complexities of water-society dynamics to guide public and private responses. The climate crisis is neither the unique cause nor the singular solution to the global water crisis. However, it provides an important political and funding framework where appropriate and effective action to mitigate and adapt would deliver significant benefits to vulnerable people. With the mid-term evaluation of progress on the SDGs in 2023 providing a bleak summary for the water goal and the other 16 goals, there is an opportunity and obligation to think of alternative actions and behaviours to a shared commitment to improve and maintain water security in a rapidly changing and unstable world.